

09/90/478  
2-8-02

## Motorcycle Having Stationary Belt Tensioner

### BACKGROUND

5 The present invention relates to a drive belt or belt tensioner for a  
motorcycle. In some motorcycles, a belt tensioner is employed to maintain  
tension in the drive belt so that the belt is properly engaged with the belt sprockets  
on the output shaft and the rear wheel. These known belt tensioners, typically  
rollers, are biased toward the drive belt with a spring or other biasing member  
such that, as the rear wheel bounces up and down with respect to the motorcycle  
10 frame and transmission output shaft, the belt tensioner moves up and down to  
remain in contact with the drive belt to prevent the belt from slipping on the  
sprockets. Other types of tensioners include chain rubs that are fixably mounted  
to the frame such that a drive chain of a motorcycle slides against the chain rub to  
thereby remove some of the slack that exists in the drive chain.

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### SUMMARY

The present invention provides a motorcycle including a frame and an  
engine/transmission assembly that includes a transmission operatively  
interconnected with the engine. The transmission includes an output shaft rotating  
20 in response to operation of the engine. The motorcycle includes a drive sprocket  
mounted to the output shaft for rotation therewith, a swingarm pivotably mounted  
to at least one of the frame and transmission for pivotal movement within a range  
of motion, and a rear wheel mounted to the swingarm for rotation with respect to  
the swingarm. The motorcycle also includes a wheel sprocket mounted to the rear  
25 wheel for rotation therewith, a flexible drive member coupling the drive sprocket  
and the wheel sprocket, and a tensioner having an axis that is fixed against both

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pivotal and translational movement with respect to the axis of the transmission output shaft. The tensioner is positioned to be in substantially constant contact with the drive member and to maintain a substantially constant belt path length as the swingarm pivots fully through its range of motion.

5           The tensioner may include a bracket fixedly mounted to the transmission, engine, and/or motorcycle frame. The tensioner may also include a roller rotatably mounted on the bracket and in contact with the drive member. The roller rotates with respect to the bracket in response to movement of the drive member.

10           The swingarm preferably pivots about a pivot axis that is non-collinear with the output shaft axis of rotation. This results in changes in spacing between the drive sprocket and the wheel sprocket as the swingarm pivots. The tensioner is positioned to maintain substantially constant tension in the drive member despite pivoting movement of the swingarm and the resulting change in sprocket  
15           spacing.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims, and drawings.

#### 20                           BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view of a motorcycle embodying the invention.

Fig. 2 is an enlarged exploded view of the rear portion of the motorcycle of Fig. 1.

Fig. 3 is an enlarged side view of the rear portion of the motorcycle of Fig. 1 in a level condition.

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Fig. 4 is an enlarged side view of the rear portion of the motorcycle of Fig. 1 in a rear wheel raised condition.

Fig. 5 is an enlarged side view of the rear portion of the motorcycle of Fig. 1 in a rear wheel lowered condition.

5 Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other  
10 embodiments and of being practiced or being carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including" and "comprising" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The use of  
15 "consisting of" and variations thereof herein is meant to encompass only the items listed thereafter. The use of letters to identify elements of a method or process is simply for identification and is not meant to indicate that the elements should be performed in a particular order.

#### DETAILED DESCRIPTION

20 Fig. 1 illustrates a motorcycle 10 that includes a frame 12 and an engine/transmission assembly 13 connected to the frame 12. The engine/transmission assembly 13 includes an engine 14 and a transmission 16 connected to the engine 14. The engine 14 and the transmission 16 of the  
25 engine/transmission assembly 13 could either include a single integral housing or separate housings connected together. The transmission 16 includes an output

shaft 18 that is rotated in response to operation of the engine 14. The motorcycle 10 also includes a steering assembly 20 and a front wheel 22 rotatably mounted to the steering assembly 20.

With additional reference to Fig. 2, a swingarm 24 is pivotably mounted to the transmission, or alternatively to the frame 12, with a pivot member 26 (e.g., a bolt or pivot pin) rearwardly of the transmission output shaft 18, and a rear wheel 28 is rotatably mounted to the swingarm 24. A spring or shock absorber 29 is interconnected between the frame 12 and the swingarm 24. The swingarm 24 and shock absorber 29 permit the rear wheel 28 to bounce up and down with respect to the frame 12 and therefore provide a smoother ride on the motorcycle 10. A rear wheel axle 30 is preferably non-adjustable or fixed with respect to the swingarm 24.

The output shaft 18 of the transmission 16 includes a drive sprocket 32, and the rear wheel 28 includes a wheel sprocket 34. The sprockets 32, 34 are fixed for rotation with the output shaft 18 and the rear wheel 28, respectively. A drive member such as a chain or the illustrated belt 36 couples the sprockets 32, 34 such that rotation of the output shaft 18 is transmitted to the wheel sprocket 34 and the rear wheel 28. A belt tensioner 38 includes a tensioner bracket 40 fixedly mounted to the transmission 16, or alternatively to the frame 12 or engine 14, and a roller 42 rotatably mounted to the bracket 40.

As can be seen in Fig. 2, a pivot axis 44 for the swingarm 24 is non-collinear with the axis of rotation 46 of the output shaft 18 of the transmission 16. Figs. 4 and 5 illustrate the extent of the swingarm 24 range of motion. The distance between the sprockets 32, 34 changes as the rear wheel 28 and swingarm 24 bounce up and down with respect to the transmission output shaft 18. The

tensioner 38 is sized and positioned such that the roller 42 remains in substantially constant contact with the drive belt 36 during operation of the motorcycle 10, and such that it maintains substantially constant tension in the drive belt 36 even as the rear wheel 28 and swingarm 24 move with respect to the output shaft 18 through the range of motion of the swingarm 24. The roller 42 rotates in response to movement of the drive belt 36. In addition, a belt path length defined by the drive sprocket 32, the wheel sprocket 34, and the belt tensioner 38 remains substantially constant throughout the range of pivoting motion of the swingarm 24. In the described embodiment, the belt path length remains constant within approximately 0.008" as the swingarm pivots through its full range of 16 degrees.

In the level condition illustrated in Fig. 3, the drive belt 36 is in contact with the roller 42 over a first arc length  $\alpha$ . When the rear wheel 28 is moved into the raised condition illustrated in Fig. 4, the rear wheel 28 is moved away from the output shaft 18, but less of the belt 36 contacts the roller 42 along a second smaller arc length  $\alpha'$ . When the wheel 28 moves into the lowered condition shown in Fig. 5, the rear wheel 28 is pivoted closer to the output shaft 18, but the resulting slack is taken up by the tensioner 38 as the belt 36 contacts a third larger arc length  $\alpha''$  of the roller 42.

Because of the positioning of the tensioner 38, there is no need for a biasing member to hold the tensioner 38 against the drive belt 36. The tensioner 38 is positionally fixed with respect to the frame 12, transmission 16, and engine 14. As used herein, "positionally fixed" means the tensioner 38 does not move in a translational or pivotal sense with respect to the frame 12, transmission 16, and engine 14, but may include a part (i.e., the roller 42) that rotates with respect to the frame 12, transmission 16, and engine 14. Alternatively, the roller 42 could be

replaced with a smooth low-friction curved surface over which the drive belt 36 slides during use, and in such a construction the tensioner 38 would not move at all with respect to the frame 12, transmission 16, and engine 14.

One embodiment of the invention includes a 4.136" diameter drive sprocket 32, a 9.925" diameter wheel sprocket 34, and a 3.000" diameter belt roller 42. In this embodiment, the components 32, 34, 42 are spaced relative to each other in order to maintain a substantially constant belt tension and belt path length. Specifically, using polar coordinates and the swingarm pivot axis 44 as the origin (0,0°), the axis of rotation 46 of the drive sprocket 32 is located at (4.000", 355.34°), the axis of rotation of the roller 42 is located at (3.772", 263.42°), and the axis of rotation of the wheel sprocket 34 is located 18.353" from the swingarm pivot axis 44 and is rotatable through a range of motion.